

### **REMARKS**

Claims 1-9, 12-13, and 15-28 are pending in the present application. In the Office Action mailed May 30, 2008, the Examiner rejected claims 1, 12, and 16 under 35 U.S.C. §103(a) as being unpatentable over Ma (USP 6,016,057) in view of Weiss (US Pub. 2005/0165294), and further in view of Kwok et al. (USP 6,373,249). The Examiner next rejected claims 2-9, 13, 15, and 17 under 35 U.S.C. §103(a) as being unpatentable over Ma in view of Weiss, and further in view of Haacke et al. (Magnetic Resonance Imaging, Haacke, E., et al., John Wiley and Sons, 1999). Claims 18-27 were rejected again under 35 U.S.C. 103(a) as being unpatentable over Ma, in view of Haacke et al. Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kassai et al. (US Pub. 2002/0188190) in view of Kwok et al.

The Examiner rejected claim 1 under 35 U.S.C. §103(a) as being unpatentable over Ma in view of Weiss, and further in view of Kwok et al. Claim 1 calls for, in part, reconstructing a uniformly fat-suppressed medical image from the MR data having fat magnetization suppressed below a uniform threshold above which the fat magnetization is deemed to have fully recovered.

The Examiner alleged that Kwok et al. discloses “a threshold to define when the fat magnetization is deemed to have fully recovered ((col. 8, lines 51-67, col. 9, lines 1-11).” *Office Action*, 05/30/08, pg. 3. The Examiner further alleged, “It would have been obvious to a person having ordinary skill in the art at the time the invention was made to provide a threshold to suppress noise and provide a mechanism for deciding the optimum number of pulses to use to suppress the signal from fat as taught by Kwok et al.” *Id.* Applicant respectfully disagrees.

Kwok et al. teaches a system where, “if the background noise of the water-only and fat-only images is removed by setting an intensity threshold just above the noise level before image combination, then the water-plus-fat image has a similar SNR as the non-fat-suppressed GRE image.” *Kwok et al.*, col. 8, ln. 66 – col. 9, ln. 3. However, the intensity threshold taught by Kwok et al. is a noise suppression feature (not a fat suppression feature) used when reconstructing interleaved water-only and fat-only MR images. Noise is not a measure of fat magnetization. Therefore, a threshold intended to reduce background noise is not a fat magnetization threshold called for in claim 1.

Because a threshold for noise-suppression cannot be interpreted to be a threshold for fat magnetization recovery, Applicant believes that the art of record fails to teach that called for in claim 1 and that it would not have been obvious to one of ordinary skill in the art to combine the teachings of Kwok et al. with those of Ma and Weiss. As such, Applicant requests withdrawal of the rejection of claim 1, and all claims depending therefrom, under 35 U.S.C. §103(a) as being unpatentable over Ma in view of Weiss, and further in view of Kwok et al.

The Examiner rejected claims 18-27 under 35 U.S.C. 103(a) as being unpatentable over Ma, in view of Haacke et al. Claim 18 calls for, in part, a computer programmed to define an ROI to be sampled for MR data acquisition, select a slice direction, zero fill at least a portion of k-space in the slice direction, and apply a fat suppression pulse to suppress signals from fat in the ROI. Claim 18 further calls for a computer programmed to acquire MR data from the ROI prior to full fat recovery, and repeatedly apply the fat suppression pulse and acquire MR data to fill a remainder of k-space with less-than-full-fat-recovery.

Claim 23 calls for a computer readable storage medium having a computer program stored thereon and representing a set of instructions that when executed by a computer causes the computer to define a slice direction, zero fill less than an entirety of k-space in the slice direction, and apply a fat suppression pulse to suppress fat signals within an ROI. Claim 23 further calls for a computer readable storage medium having a computer program stored thereon that when executed by a computer causes the computer to acquire MR data from the ROI prior to full recovery of magnetization of fat within the ROI, and repeat application of the fat suppression pulse and data acquisition to fill a remainder of the entirety of k-space with less-than-full-fat-recovery MR data.

In the claim 18 rejection, the Examiner admitted that Ma does not explicitly disclose zero-filling in the slice direction or repeated application of the fat suppression pulse, but alleged that Haacke et al. discloses “zero-filling of 3D data in the slice direction (p. 812).” *Office Action*, 05/30/08, pg. 9. The Examiner further alleged that Haacke et al. “discloses an inversion recovery sequence using repeated application of the fat suppression pulse every TR seconds (Figure 17.6, page 429).” *Id.*, pg. 9-10. The Examiner also alleged that it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the invention of Ma to include zero-filling of 3D data to improve the apparent resolution of the image in the slice direction, and to modify the Ma/Weiss combination to use repeated application of the fat-suppression pulse because the fat magnetization recovers somewhat over time and it becomes necessary to re-suppress it using another fat-suppression pulse. *Id.*

However, Haacke et al., while disclosing zero-filling, makes no reference to zero-filling in the slice direction. The term “zero filling” appears once in the cited passage.

If the central k-space data has a gain of 96dB, say, and the DIFT is taken by zero filling the missing (but to-be-collected data) then the central point  $s(0)$  with value  $N^2\rho_0\Delta x\Delta y$  transforms to  $\rho_0$  in the image domain for all  $x, y$ . *Haacke et al.*, pg. 812.

There is no indication in the cited passage that the zero-filling mentioned is in the slice direction. Slice direction is not even discussed in the cited passage.

Furthermore, Haacke et al. does not disclose repeated application of the fat suppression pulse every TR seconds as the Examiner alleged. Rather, Haacke et al. discloses an inversion recovery signal but does not discuss multiple fat suppression pulses. Haacke states,

Inversion recovery signal behavior and the choice of the recovery period to null a specific tissue. If data can be collected at the zero crossing (null point) of fat  $T_1 = t_{\text{null}, f}$  or water  $T_1 = t_{\text{null}, w}$  that particular tissue can be suppressed from the image. In this figure, fat and muscle (with essentially no fat component) signals are plotted for an IR sequence using a 1 s  $T_R$ . *Haacke et al.* Figure 17.6, pg. 429.

Nowhere does the cited material disclose the repeated application of fat suppression pulses.

As Haacke et al. does not disclose zero-filling in the slice direction, and also does not disclose repeated application of fat suppression pulses, it would not have been obvious for one of ordinary skill in the art to combine the teachings of Haacke et al. with those of Ma, or with those of Ma and Weiss, as suggested by the Examiner. Because the cited references do not disclose all of the elements called for in claim 18, Applicant believes claim 18, and all claims depending therefrom, to be patentably distinct from that disclosed in Ma, Weiss and Haacke et al., either alone or in combination.

In the claim 23 rejection, the Examiner again alleged that Haacke et al. discloses zero-filling of 3D data in the slice direction (p. 812), and an inversion recovery sequence using repeated application of the fat suppression pulse every TR seconds (Figure 17.6, page 429). *Office Action*, 05/30/08, pg. 11. Applicant has fully addressed these allegations above, and based at least on the above arguments, Applicant believes claim 23 and all claims depending therefrom are patentably distinct from that disclosed in Ma, Weiss and Haacke et al., either alone or in combination. As such, Applicant respectfully requests withdrawal of the rejection of claims 18-27 under 35 U.S.C. 103(a) as being unpatentable over Ma, in view of Haacke et al.

The Examiner rejected claim 28 under 35 U.S.C. 103(a) as being unpatentable over Kassai et al. in view of Kwok et al. Claim 28 calls for an MR apparatus comprising means for exciting nuclei to precess at a given Larmor frequency when subjected to a substantially uniform magnetic field, and means for fastly acquiring 3D MR data only when fat magnetization is suppressed below a full-recovery threshold during breathhold moments.

As in the claim 1 rejection, the Examiner alleged that Kwok et al. “discloses a threshold to define when the fat magnetization is deemed to have fully recovered (col 8, lines 51-67, col. 9, lines 1-11).” *Office Action*, 05/30/08, pg. 13. The Examiner also alleged, “It would have been obvious to a person having ordinary skill in the art at the time the invention was made to provide

a threshold to suppress noise and provide a mechanism for deciding the optimum number of pulses to use to suppress the signal from fat, as taught by Kwok et al.” *Id.*

As explained above, Kwok et al. teaches a system in which “background noise of the water-only and fat-only images is removed by setting an intensity threshold just above the noise level before image combination” so that “the water-plus-fat image has a similar SNR as the non-fat-suppressed GRE image.” *Kwok et al.*, col. 8, ln. 66 – col. 9, ln. 3. The intensity threshold taught by Kwok et al. is a noise suppression feature distinct from the full recovery threshold called for in claim 28. That is, a noise-suppressing threshold cannot be interpreted to be a full recovery threshold as called for in claim 28.

As stated above, Applicant believes the Examiner erred in equating the noise-suppressing intensity threshold taught by Kwok et al. with the full recovery threshold called for in claim 28. Therefore, it would not have been obvious to one of ordinary skill in the art to combine the teachings of Kwok et al. with those of Kassai et al. Accordingly, Applicant requests withdrawal of the rejection of claim 28 under 35 U.S.C. 103(a) as being unpatentable over Kassai et al. in view of Kwok et al.

Therefore, in light of at least the foregoing, Applicant respectfully believes that the present application is in condition for allowance. As a result, Applicant respectfully requests timely issuance of a Notice of Allowance for claims 1-9, 12-13, and 15-28.

Applicant appreciates the Examiner’s consideration of these Amendments and Remarks and cordially invites the Examiner to call the undersigned, should the Examiner consider any matters unresolved.

Respectfully submitted,

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